We have thus endeavoured to give our readers an idea of the contents of the volume under review, and they will probably agree with us that it constitutes a valuable addition to our medical literature—that it is a book which is wanted, notwithstanding that so many treatises and histories of the subjects of the work have already been published. It is not an elaborate scientific treatise, gotten up and written with the skill and carefulness characteristic of the books prepared by Dr. Bartlett and Dr. La Roche. It is, however, a very interesting and a very readable book. It conveys a great deal of valuable information, and supplies a want which has been felt of a succinct and satisfactory statement of the application of the views and discoveries of recent writers on physiology and pathology to the various fevers, in the treatment of which, as well as in prophylaxis, the practising physician feels so much the want of more light and of greater certainty.

G. C. S.

ART. XIII.—*A Manual of Human Microscopic Anatomy.* By A. KÖLLIKER, Prof. of Anat. and Physiol. in the Univ. of Würzburg. With 249 illustrations. London, J. W. Parker & Son, 1860.

THE name of Professor Kölliker has long been identified with microscopical anatomy, and most of our readers are familiar with the English translation of the first German edition, issued in 1853–4, under the auspices of the *old* Sydenham Society, and republished in this country in 1854. Since that period two German editions have appeared; one in 1855, and one in 1859. The present English version, we are told, "is, in the main, a condensed version of the second German edition (of 1855). But every material addition that has been made to human microscopical anatomy, up to the present date, will be found incorporated in it. The book is, therefore, brought well up to the third German edition—that of 1859."

The mere issue of a new edition of a work so well known would require no more than a bare notice at our hands, were it not that it contains a frank acknowledgment of the accuracy of certain new histological facts of the highest doctrinal importance at the present time.

Those who have been interested in the gradual development of the cell-doctrine, and who have watched the complete revolution it has recently undergone in the hands of such men as Remak, Reichert, and above all of Virchow, will remember well that the general idea underlying the histogenetic doctrines of the earlier editions of Kölliker's Manual, was an acknowledgment of Schwann's theory of free-cell-formation. In fact, though an independent observer of the highest order, a careful perusal of these earlier editions shows that Kölliker was in many respects a disciple of Schwann, in his doctrinal ideas. Like Schwann, he saw in the fluid or semi-solid intercellular material the cyto-blastema out of whose plastic substance the cells had been produced; and while stubborn facts compelled him to admit that "botany knows no free cell development," and that "free cell development is in man and the higher animals far less common than has been hitherto assumed," he yet believed Schwann's theory to be applicable to "the development of the chyle and lymph corpuscles, of the cells of certain glandular secretions (spermatic cells, ova), and gland-like organs (closed follicles of the intestine, lymph glands, splenic corpuscles and pulp, thymus); lastly, of the cellular elements of the pregnant uterus,

in the corpus luteum, in the medulla of fœtal bones, and in the soft ossifying blastemata." When in addition to this long list it is remembered that Kölliker believed that "in fact *all pathological cell-formation* properly comes under this head," it will be understood that Schwann's doctrine played a large part in his notion of the process by which tissues are produced.

So well has this been appreciated that many of those who, without personally investigating the subject, have opposed the teachings of Virchow and his school, have relied on Kölliker as a strong authority against the new views, and more than one recent publication has rejected the progressive ideas, and clung to the old doctrines, reposing on Kölliker's work for their justification.

But while a motley host of quill-drivers were beating back the wave of progress as best they might, the little band of practical microscopists who submitted Virchow's new law "omnis cellula ex cellula" to the test of actual observation, were one by one won over to his side. Among these converts we now find Kölliker.

The present English edition of his "Manual" is issued under his own supervision at his own instance, for reasons set forth in its preface by himself. The modifications in views are therefore *his own*, and not the botch work of any meddling editor. And of these modifications we have first to notice an utter renunciation of that theory of free-cell development which has made the name of Schwann so famous.

Let our author speak for himself.

"§ 9. FORMATION OF CELLS.—With regard to the formation of cells, a distinction has hitherto been made between the *free origin* of them, and their production *through the intervention of other cells*. The farther, however, investigation is prosecuted, the occurrence of a free cell-formation becomes more and more doubtful; and it appears that all animal cells only arise, as in plants, in dependence upon other pre-existing cells. In this process of cell-multiplication, it is pre-existing cells which either produce secondary cells, as they are called, or multiply by division—*endogenous cell-formation, and cell-formation by division*. The cell-nuclei always play a very essential part in the multiplication of cells, and appear as the proper centres of formation for their evolution.

"Whilst *Schwann*, in animals, in contradistinction to plants, regarded the free cell-formation as being the more frequent—that by the intervention of other cells, more as the exception—observers are now coming more and more to the conclusion that even in this respect animals and plants agree. As for me, I have already long since shown (*Entw. d. Cephal.*, 1844; *Ann. d. sc. Nat.*, 1846) that in embryos all the tissues are built up of the descendants of the cells which have arisen after the cleaving of the yelk; and that even in the adult, in the most widely-distributed tissues consisting of cells, as in cartilages and in horn, free nuclei nowhere occur. Accordingly, I found myself constrained, in the first edition of my German *Handbook of Histology*, to limit the free cell-formation very much. Quite recently, *Virchow* (in *Beit. zur Spec. Path. u. Therapie*, 1854, p. 329) has made known a series of facts, from the department of pathological anatomy, which show that in many places where formerly a free cell-formation was admitted, it does not occur. If to these facts are added the new observations of *Virchow*, with regard to the development of bones, as well as the recent investigations into the formation of the lymph-corpuscles, *we may indeed conclude that a free formation of cells does not anywhere exist.*" (p. 16.)

It will thus be seen that Kölliker has formally renounced all adhesion to the free-cell-development theory, and has deliberately accepted *Virchow's* law of *continuous development* of cells only out of cells as an indisputable fact. And while theorists of variable character and calibre have been abusing *Virchow* as an innovator, and rejecting *his facts on theoretical*

grounds, it is somewhat amusing to contrast with their ideas of the great Berlin pathologist, the sober opinion of a man like Kölliker.

"The treatises of *R. Virchow*, who, of all living pathologists, has made the best observations, in his *Archives* and in the *Würzburg Proceedings*, are of the greatest importance." (p. 6.)

The support of an observer so careful and so independent as Kölliker will give great weight to the new views of cell-development; and we may, perhaps, regard the doctrine of the spontaneous generation of cells as being as completely exploded as the doctrine of the spontaneous generation of animals.

And this one possibility of the evolution of form out of the formless, of the capability of organic fluids to assume bodily shape by their own energies, once denied authoritatively, how many curious pathological and physiological dogmas, not long ago quite dominant, are scattered forever to the winds. How utterly and completely that splendid exudation theory, which for twenty years has been dominant in the scholastic comprehension of morbid processes, falls to the ground, if the transuded fluid can in no manner serve as the *blastema* or form-producing liquid for new elements, if, in a word, the fluids be passive, and the organic forms the active agents in the organic processes. How the old solidistic ideas, so long supposed to be quite trampled out of existence by the refined and systematic humoralism of Rokitansky and his followers, loom up once more with fresh force and vigour in a newer and more scientific dress!

It is not in our power to follow Kölliker through the six hundred pages of this elaborate volume. Much of the matter is identical with the details of the Sydenham edition, for many of these points are facts forever acquired for science; but much also has been modified, the recent literature of the subject has been carefully considered, whole paragraphs have been remodelled or re-written, and the volume may be regarded as not merely an improvement upon former editions, but as wholly superseding them. To comment upon all the new points introduced would be to review the whole ground of histological progress during the past ten years, a task far too large for our present purpose. We shall, therefore, conclude with a few remarks on a subject which is important chiefly from its pathological relations.

Within the last few years "connective tissue" has been made the object of a series of most interesting observations, and has constantly assumed fresh importance until the best modern investigators (Virchow, Weber, &c.) have come to look to its elements for the origin of the great majority of those pathological products (pus, lymph, cancer cells, &c.), which were formerly thought to spring up spontaneously in an organizable blastema. The true anatomy of connective tissue, and especially the process of its development is a subject related in the nearest manner to pathological doctrine. In his conceptions of connective tissue, as laid down in our present volume, Kölliker, while obliged to go a long way towards the abandonment of the older notions, as taught by Schwann, remains adherent to one of Schwann's notions, which careful observation shows so clearly to be incorrect that we must confess surprise at seeing it retained in this volume. He still asserts that the white fibrous element of connective tissue is developed by the elongation and subsequent fibrillization of the primitive embryonic cells, the nucleus of the cell remaining permanently imbedded in the bundle thus produced.

Pathological studies which accord fully in their results with Virchow's

doctrine of the histogenesis of connective tissue and the study of several human embryos from one inch long upwards, have so fully convinced us that this idea of the development of the white fibrous tissue so called is incorrect, that we cannot close without making a few remarks upon the subject; for in fact white fibrous tissue wherever this exists represents not transformed cells, but the transformed matrix or intercellular substance, and this is true in the tendons and subcutaneous areolar tissue as well as in the so-called fibro-cartilages, where it has long been acknowledged.

Kölliker, with great propriety, includes, under the "tissues of connective substance" (connective tissue group), not merely connective tissue properly so called, but also mucous tissue, yellow elastic tissue, cartilage, bones, and teeth.

All these tissues possess, in common, certain structural and histogenetic points of the highest interest.

They all originate as a mass of cells (primitive embryonic cells) nearly or quite in contact, between which as the developmental process proceeds a variable amount of fluid, semi-solid or solid intercellular substance, or matrix arises.

The cells multiply in number by division, matrix being subsequently developed between the broods of cells in the same fashion as between the original or parent cells of the tissue.

The cells may remain rounded or oval, increasing to a variable size, and presenting great diversities in contents (cartilage cells, adipose tissue cells), or they may become branched and stellate, the processes of the branched cells usually anastomosing so as to form intricate networks adequate to the transportation of fluids (connective tissue cells, cells of mucous tissue, pigment cells, bone cells, bone lacunæ so-called). Or finally the cells may be transformed into long hollow fibres anastomosing with each other, and losing in their adult condition almost every trace of their cellular origin (yellow elastic fibres, dentinal tubules, and the like).

In the actual condition of the adult tissues, these differences in the form of the cells are not of that sharply-defined kind, that every tissue of the group has its specific cells by which it is distinguished; on the contrary, they pass into each other by the most gradual transitions, which is quite what should have been expected, when it is borne in mind that they all arise by the transformation of cells originally identical.

The matrix or intercellular substance above alluded to as being developed between these cells *pari passu* with their development, is subject to as great a diversity in its transformations as the cells themselves; besides the greatest diversities in quantity, the following chief qualitative transformations may be noted between which every grade of transition exists.

(1.) *The matrix may remain semi-fluid, soft and jelly like*, yielding a filamentous precipitate with acetic acid. This is "mucous tissue" so called, a term which Virchow applies to the vitreous humour of the eye, the umbilical cord of the new-born child, the cutaneous and subcutaneous tissues of the fœtus, and many pathological formations identical in structure with these; and although Kölliker limits this class within much narrower bounds, allowing the term mucous tissue to be applicable only to the vitreous humour, his description of the other tissues above mentioned accords so completely with the facts of the case, and his rejection of the term mucous tissue as applied to them depends so entirely upon his desire to classify tissues as they *become* in the adult state, rather than as they begin in the embryonic condition, that the precise limits of his classification is a matter

which modifies in no essential degree the comprehension of the subject to be derived from his writings.

(2.) *The matrix may become solid, still retaining, however, a homogeneous, more or less completely translucent character.* This is especially the case in the *cartilages* (true or homogeneous cartilage, articular, costal cartilages, &c.). The essential character of cartilage, however, is not to be found in this state of the matrix, for cartilages, at the beginning, are a mere mass of cells without any matrix; and this state, which is the normal initial condition of every cartilage, may remain permanent under certain circumstances, as is normally the case, for example, in the cartilage of the external ear of the *mouse* and many other mammals.

(3.) *The matrix may become solid, and fibrillate as it solidifies, more rarely after it has become homogeneously solid. The fibrillated matrix constitutes the so-called white fibrous tissue.* The fibrillization begins in the already existing fluid or jelly-like matrix in the immediate neighbourhood of the cells, and proceeds from these outward into the matrix, *and hence it happens while the process is yet incomplete, if the tissue be torn with needles, fragments of the fibrillated matrix are readily isolated, containing the cells imbedded, and the delicate cell wall being easily overlooked if appropriate treatment is not resorted to, the whole fragment has been regarded first by Schwann and his followers, and even yet by Kölliker, as a metamorphic condition of a cell, whereas in fact it represents a cell, plus a certain exterior and adhering fragment of the imperfectly formed matrix.*

The essential difference between such a mass of connective tissue as is found in a tendon or a ligament, and the areolar tissue so called, is to be found first in the mode of arrangement of the branched and anastomosing connective tissue cells, and secondly, in the fact that the whole or nearly the whole of the matrix solidifies in a fibrillated form in the tendon, while in the areolar form of tissue, only a certain limited amount of fibrillization takes place upon the cells and their branches, leaving more or less roomy spaces (areolæ) between the anastomosing "bundles" thus produced.

(4.) The *matrix having solidified in either of the above methods may calcify from the deposit in it of lime salts,* as in the well-known process of ossification. The cells then become the *bone cells,* which repose in spaces or lacunæ which in the dried and polished slices of the tissue constitute the well known bone lacunæ.

Any of the tissues included in the above categories may undergo ossification, but the two tissues in which this is most frequent are the cartilages (development of bone from fœtal cartilage) and connective tissue (development of bone from periosteum, and in exceptional cases ossification of tendons, &c.). Even the mucous tissue may undergo ossification under favourable conditions (*e. g.,* the rare but authentic ossifications of the vitreous humour).

Such is a hasty survey of the modern conception of the connective tissue group, in which, with the exception of the development of the white fibrous matrix, Kölliker agrees perfectly with the more recent investigators. If now narrowing down our subject by the exclusion of bone, teeth, cartilage, and mucous tissue, we look for a moment exclusively at the typical tissue of the group connective tissue proper, we shall find that in the adult this tissue consists essentially of CELLS (connective tissue cells, connective tissue corpuscles of Virchow, cells of connective substance, plasm cells and tubes of Kölliker). These cells are small, nucleated, generally branched, more

or less stellate, and anastomose by long processes, or tubes, so as to form a network; between them a solid matrix, translucent, granular, or fibrillated, exists to a greater or less extent. These cells, which are readily demonstrated after colouring them by the imbibition of carmine (though they may be seen without reagents under favonrable circumstances), are the essential anatomical element of connective tissue, just as bone cells are the essential anatomical element of bone. The transformation of some of these cells into yellow elastic fibres, into pigment cells, or into adipose vesicles, the more or less complete fibrillization of the matrix, and its increase or diminution in quantity, its complete solidification or the formation in it of vacuoles of various sizes, these are circumstances which modify much the external aspect of the tissue in particular localities, and fit it to perform the special functions assigned to it in each; but everywhere, no matter what transformations some of the cells have undergone, a certain number of them continue to present the characters above described, and thus retain the typical anatomy of the tissue. And hence the anatomist, wherever he recognizes these elements, may affirm connective tissue to exist. Well-marked and beautifully anastomosing networks of such cells may be seen in thin sections of the brain and spinal cord, in the kidney, and in many other situations in which up to a very recent period the existence of connective tissue has been denied by respectable anatomists. Everywhere the *connective tissue cells* serve at least a *twofold purpose:* on the one hand, they serve to convey the nutritive juices into the little territories of tissue, that lie within the meshes of the smallest capillaries that carry red blood—on the other hand, as *they still retain the power of multiplying by division and producing broods of secondary cells under the influence of appropriate irritations*, they serve as the point of departure for the production of reparative material, and in virtue of the same set of nutritive laws acting under anomalous conditions may give birth to broods of cells, constituting the several so-called pathological new formations. If with this origin of the majority of pathological tissues, we bear in mind the fact that even in the physiological condition the tissues of the connective tissue group are mutually convertible (*e. g.* the transformation of cartilage and connective tissue into bone, and of bone into connective tissue in the formation of the marrow cavity of the long bones, &c.), we shall readily understand why it is that the vast majority of pathological new formations are either *evidently connective tissue*, as in cicatrices, fibroid and fibro-plastic growths, fibrillated lymph, &c. &c., *cellular elements rudimentary to the same*, typically developed or variously deformed and aborted, as corpuscular lymph, pus, sarcomata, tubercle, cancer; or finally *tissues of the connective tissue group* into which ordinary connective tissue is physiologically convertible, as cartilage, adipose tissue, bone, &c. &c.

We will dwell no longer on this subject, to which we have only alluded on account of its intimate connection with the modern doctrine of pathological new formations. The production of new formations out of connective tissue is not the whole sum and substance of pathological new formations; other tissues, especially the epithelia, may luxuriate into pathological growths, but yet connective tissue plays so large a role in the matter that it demands the most earnest attention. In conclusion, we commend the new volume of Kölliker to all our readers, as a safe guide to a knowledge of the minute anatomy of the tissues, and as presenting a closer approximation to the actual state of histological information than is to be found elsewhere in the English or any other language.

J. J. W.